Tribology Research User Center

TRUC

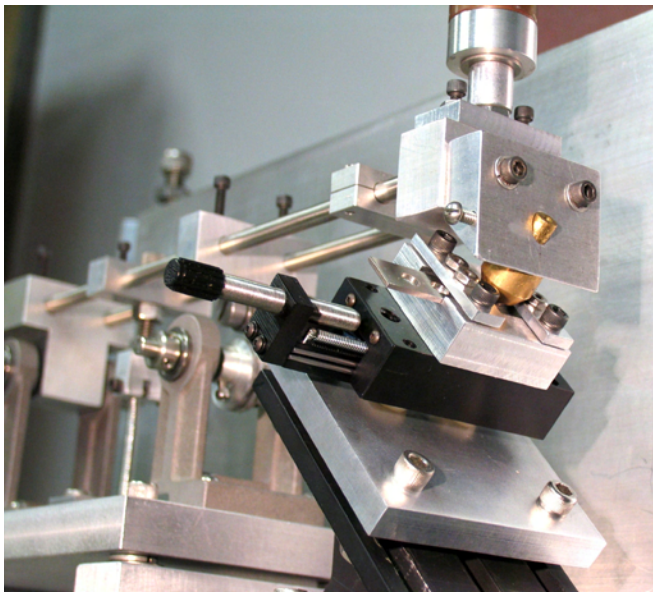
The Tribology Research User Center (TRUC) is one of six user centers in the High Temperature Materials Laboratory (HTML), a DOE User Facility dedicated to solving materials problems that limit the efficiency and reliability of systems for power generation and energy conversion, distribution, storage and use. The TRUC provides world-class facilities and a staff of technical experts for characterization of material properties and performance of load-bearing, engineering surfaces and the materials that separate them.

The mission of the TRUC is to provide a collaborative environment and a variety of tools and techniques to investigate the response of materials to friction- and wear-causing environments. Consequently, our vision is to be a national resource for providing solutions to technology-enabling barriers related to the friction, wear, and lubrication characteristics of high-performance materials. Primary customers are U.S.-based companies and universities, but the TRUC staff has worked with U.S. government agencies as well. In 2007, the new TRUC was formed to redefine the scopes of the two user centers that preceded it: the Machining, Inspection, and Tribology User Center (MITUC) and the Friction, Wear, and Machinabililty User Center (FWMUC).

The word tribology stems from the Greek 'tribos,' which means "rubbing." It describes a broad interdisciplinary field of science and technology ranging from studies of frictional interactions on the nanometer scale to massive earth movements on the megascale. The TRUC facilities support tribological research and characterization of new materials, coatings, and surface treatments for diverse applications like energy-efficient engines, brakes, farming equipment, medical implants, and manufacturing. Users vary from university faculty involved in fundamental studies of the nature of friction in thin films to applications engineers investigating wear-resistant facings for rolling mill rolls, emission-control valves in diesel engines, and down-hole oil well casings. The diversity of past users has given us a unique experience base from which to help future users solve their tribology problems effectively.

Helping Material Developers and Designers

Selecting appropriate materials, surface treatments, coatings and/or lubricants for friction- and wear-critical applications can present a formidable challenge for designers and material developers. Sometimes an existing material will perform satisfactorily, but under severe operating conditions and cutting-edge designs, new high-performance materials may be needed. The path to a solution often involves laboratory scale testing, data collection, and subsequent analysis. Experienced TRUC staff members advise users on the best approach to their specific friction or wear problem, whether it involves basic research or applies to a particular type of machinery. ORNL's experience in friction and wear research spans over a quarter century and encompasses a wide variety of materials, including ceramics, metal alloys, carbon materials, composites, solid lubricants, polymers, and intermetallic alloys. Customized test apparatus are available to produce various forms of wear such as unidirectional sliding, reciprocating sliding, scuffing, repetitive impact, belt abrasion, and slurry abrasion.

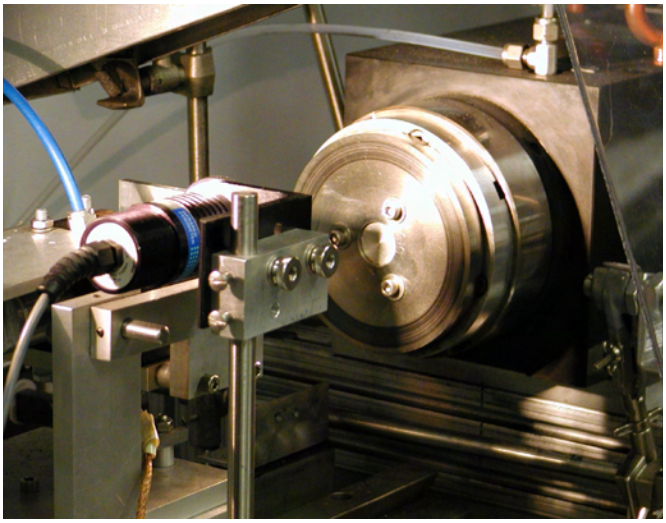


Repetitive impact test apparatus also imparts slip.

Tribotesting Capabilities

- Customized friction and wear testing apparatus for a variety of specimen types
- Lubricated and non-lubricated contact conditions
- Instrumented scratch testing for hardness and adhesion studies
- Hot hardness testing
- High-temperature friction and wear testing up to 1000°C
- Abrasive wear and grindability evaluations related to machining
- Repetitive impact testing with varying slip

More than fifteen kinds of friction and wear testing configurations are available, including a high-speed sub-scale disc brake apparatus and a high-temperature repetitive impact test system designed to study the durability of diesel engine exhaust valves at temperatures to 850°C. Supporting instruments include a mini-viscometer, microindention hardness tester, optical and measuring microscopes with image analysis, and a micro-abrasion system to measure coating thickness.



High-speed sliding test apparatus for brake materials

Web: http://html.ornl.gov

html HIGH TEMPERATURE MATERIALS LABORATORY

Setting the Standard

Over the years, ORNL has led the development of three new ASTM standards for wear and friction testing (G 133, G 171, G 181) and has participated in the development of several others (G 99, G 164, G 174). One of these standards (G 181) is a key method to measure the friction of piston rings and cylinder liners in engine-conditioned oil and is used by a major diesel engine manufacturer.

The use of standards, where applicable, helps to ensure the repeatability of our data and the ability to compare our results with past work under similar test conditions. We recognize the importance of understanding the attributes and limitations of each test method in order to more fully appreciate the implications of the data. Working with the standardization process provides a firm grounding when it comes to helping TRUC users interpret their results, and it strengthens the relationship between researchers and end-users.

Dimensional Metrology Instruments

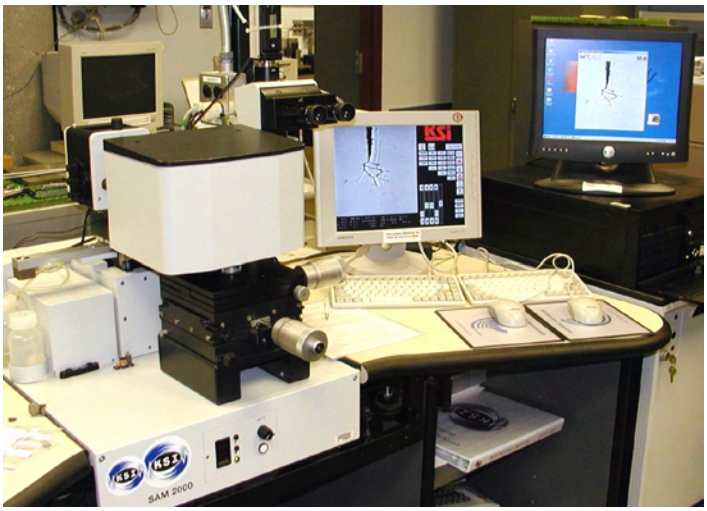
The TRUC maintains outstanding dimensional metrology and surface texture measuring equipment to assist HTML guest researchers to characterize the size, shape, and surface roughness of their samples. Our highly qualified technical staff is available to assist researchers in the operation of the more complex equipment, such as the coordinate measuring machine and atomic force microscope.

Measurement Capabilities

- Contact (stylus-based) and non-contact (laser-based) surface topography measurement instruments
- Image analyzer for high-magnification feature measurements
- 3D optical imaging apparatus for micro-topography
- Unique scanning acoustic microscope (SAcM) for imaging subsurface flaws with high frequency sound waves

Most of the metrology instruments are computer controlled, and data can easily be exported to advanced analysis software. Users are also provided with image files for use in presentations and publications.

Overall, the TRUC represents a unique national resource that supports advances in materials science and technology by providing expertise in tribology, metrology, and the micromechanical response of surfaces.



Unique Scanning Acoustic Microscope can probe beneath surfaces for the origins of wear.

TRUC Staff

Peter J. Blau, User Center Leader
E-mail: blaupj@ornl.gov
Phone: (865) 574-5377
Fax: (865) 574-4913

Jun Qu
E-mail: qujn@ornl.gov
Phone: (865) 576-9304

Randy Parten
E-mail: partenrj@ornl.gov
Phone: (865) 574-4884

Sponsor

The HTML User Program is sponsored by the
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Vehicle Technologies Program

Oak Ridge National Laboratory is managed by UT-Battelle, LLC for the U.S. Department of Energy under contract DE-AC05-00OR22725.